The International Movement of Seed

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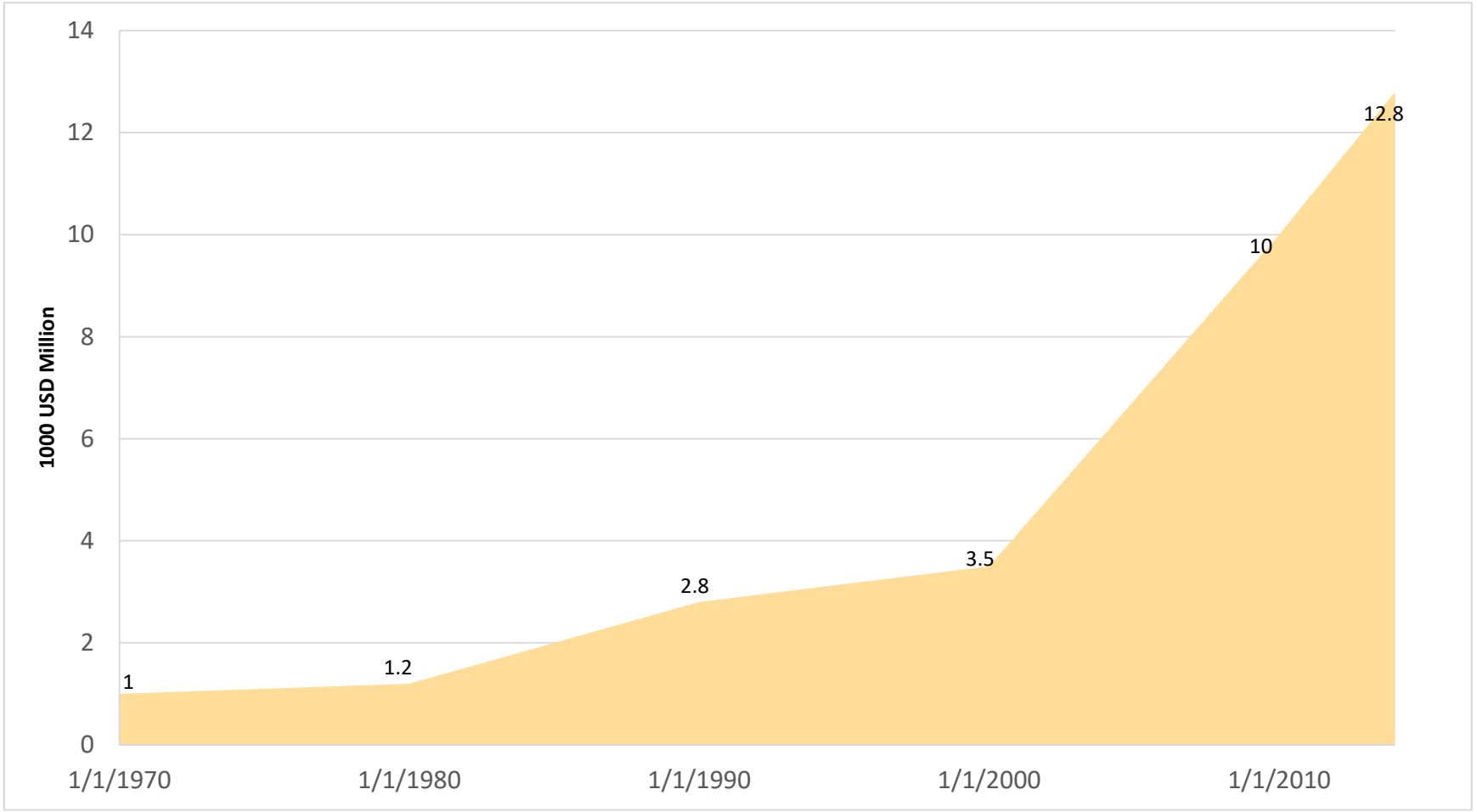
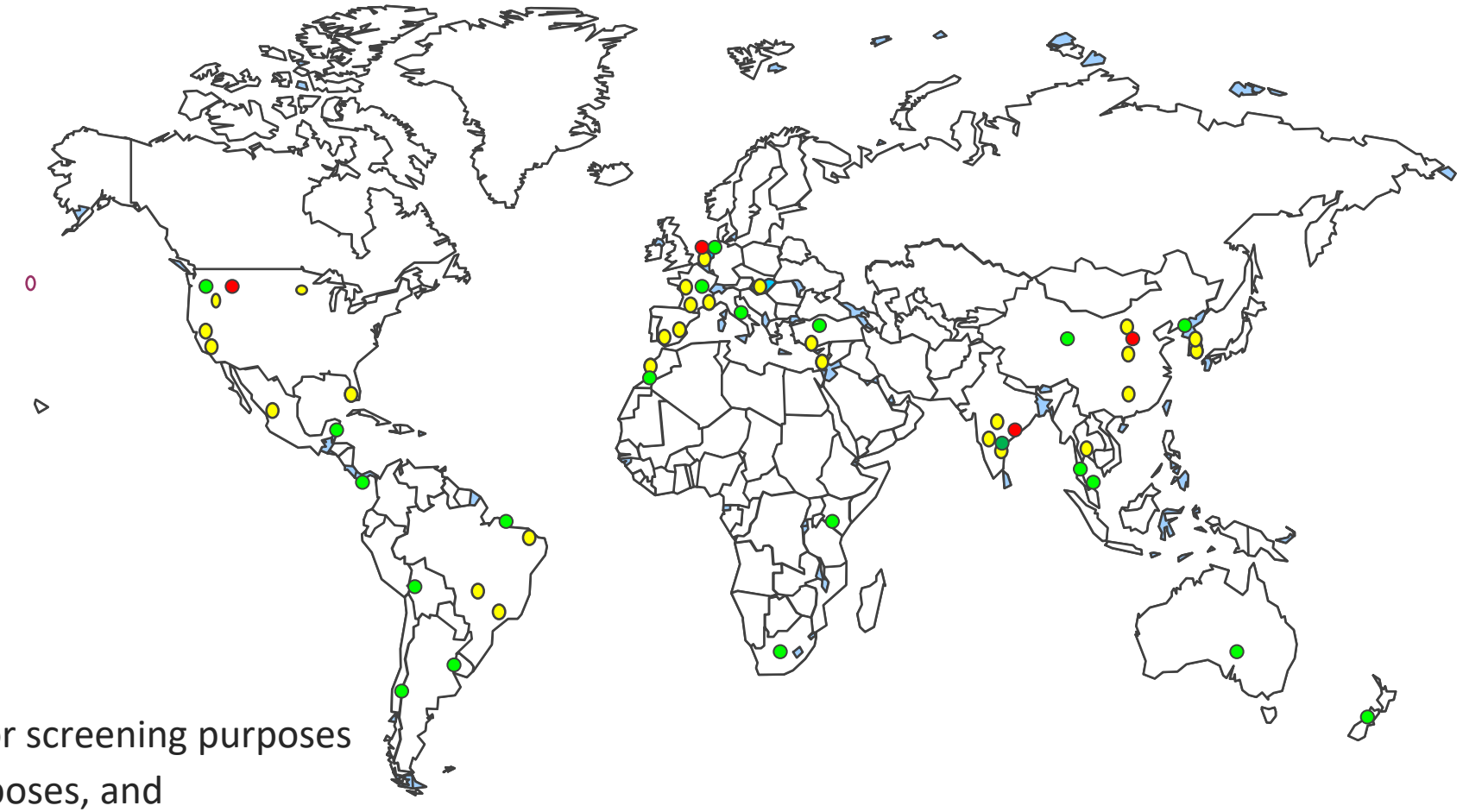
Growth in Seed Trade



The seed business today

Product development and seed production in multiple countries

- R&D Centre
- Seed production site
- Distribution/Processing



<u>The movement of seed</u>

Germplasm for R&D purposes

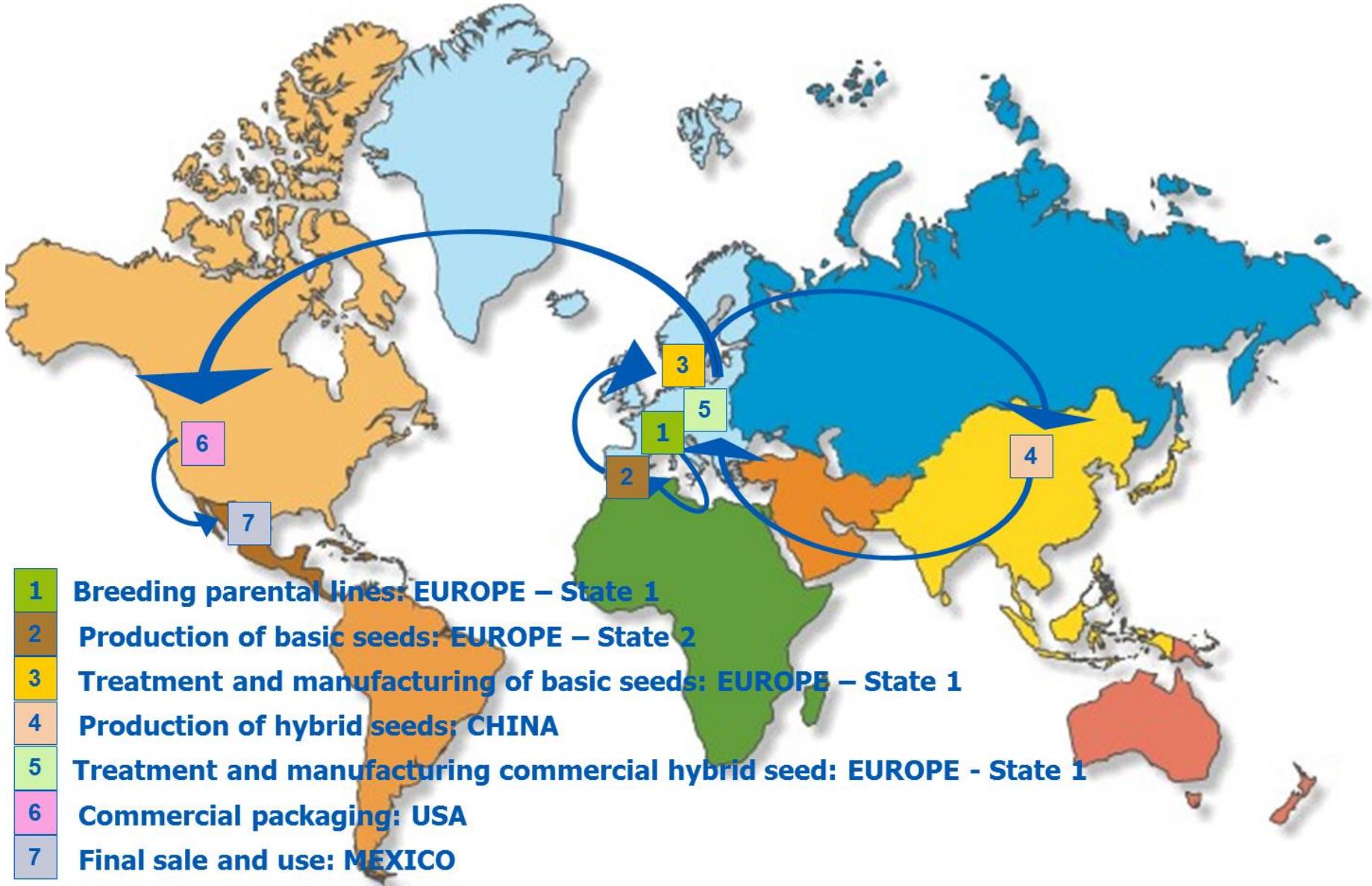
Experimental lines and hybrids for screening purposes

Basic seed for multiplication purposes, and

Commercial varieties and hybrids for marketing

Breeding, production and marketing of tomato seed

An example



The Value of Traded Seed, 2017 (US$ million)

Approx. total value US 12 US$ million

	Exports	Imports
Australia	111	125
China	205	366
India	101	121
Indonesia	16	30
Japan	173	274
New Zealand	115	37
Philippines	4	29
South Korea	70	117
Thailand	116	44
Vietnam	13	49

International Plant Protection Convention (IPPC)

An international treaty that aims to secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products

- Recognizes the necessity for international cooperation in controlling pests of plants and plant products and in preventing their international spread,
- Recognizes that phytosanitary measures should be technically justified, transparent and should not act as a barrier to international trade;
- Provides a framework for the development and application of harmonized phytosanitary measures and the elaboration of international standards to that effect

International Standards on Phytosanitary Measures (ISPMs)

- ISPMs are the standards, guidelines and recommendations recognized as the basis for phytosanitary measures applied by WTO Members
- They aim to achieve international harmonization of phytosanitary measures, with the goal of facilitating trade and avoiding the use of unjustifiable measures as barriers to trade
  - THE FRAMEWORK FOR A PEST RISK ANALYSIS – ISPM 2
  - EXPORT CERTIFICATION SYSTEM – ISPM 7
  - GUIDELINES FOR PHYTOSANITARY CERTIFICATES – ISPM 12
  - INTERNATIONAL MOVEMENT OF SEEDS – ISPM 38 (adopted in 2017)

Pest Risk Analysis (PRA)

PRA Stage 1: Initiation — Identify pathway that may allow the introduction and/or spread of a potential quarantine pest

Pathway Any means that allows the entry or spread of a pest

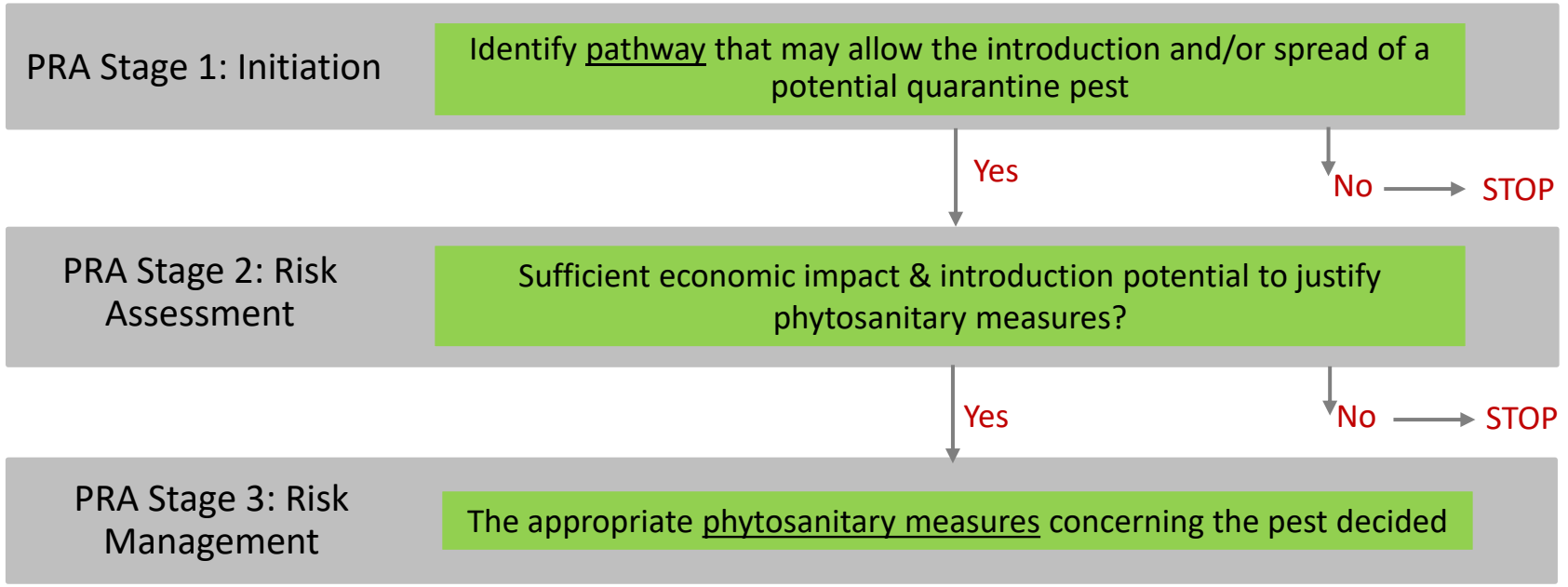
Seed-borne pest A pest carried by seeds externally or internally that may or may not be transmitted to plants growing from these seeds and cause their infestation

Seed-transmitted pest A seed-borne pest that is transmitted via seeds directly to plants growing from these seeds and causes their infestation

When is seed a pest risk?

- Seed is a pathway (e.g. Clavibacter michiganensis michiganensis on tomato seed)
- Pest can be found as a contaminant of the seed of the crop but the crop/species itself is not a host (e.g. Karnal bunt spores on soybean seed)
- Crop/species in question is not a host (e.g. Pseudomonas syringae pv. lachrymans, Puccinia allii, Septoria petrosellini on pepper)
- Seed is not the pathway (e.g. Tomato yellow leaf curl virus on tomato seed)
- Inadequate evidence that seed is the pathway (e.g. Curvularia lanata on pepper seed found in one report only)

Pest Risk Analysis (PRA)



Phytosanitary measure Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests

Some key features of ISPM 38

- PRAs to provide technical justification
- Import countries should work towards requiring recommended standard wording for ADs and exporting countries should use these wording
- (re)export: NPPOs issuing (re)export certificates should make sure they comply with import requirements. NPPOs should be willing to add additional information on export certificates to facilitate future re-export
- Importing countries should be willing to accept equivalent phytosanitary measures

Standard Recommended Wording (ISPM 12)

	Variations (Total)
1. The shipment is free of (name of pest or soil)	88 (95)
2. The shipment is free of (name of pest) based on laboratory analysis	24 (35)
3. (name of pest) is not present in (name of country)	17 (19)
4. The shipment originates from a pest free area for (name of pest)	34 (39)
5. The shipment was produced in a pest free production site for (name of pest) **OR** This shipment was produced in a pest free place of production for (name of pest)	29 (33)
6. The place of production was inspected during the last vegetative period and found free of (name of pest)	51 (60)
7. The plants originated from mother plants that were analyzed using an appropriate techniques and found free of (name of pest)	44 (50)
8. (Unable to classify)	67 (71)
(4 Languages – EN, FR, ES, PO) TOTAL	402

ISPM 38 now in implementation phase

ISF's Regulated Pest List Initiative

The Regulated Pest List Initiative

Facilitate the harmonization of phytosanitary requirements for seed

- by developing a database of information on regulated pests of internationally traded seed species, based on
  - a scientific assessment of whether they are a pest risk
  - the experience of the seed industry in managing this risk

The Regulated Pest List Database

ISF regulated pest list database

Remove all filters - List of references by Crop Brassica (Brassica spp.) GET THE PDF List of references by Pest Type Bacteria GET THE PDF

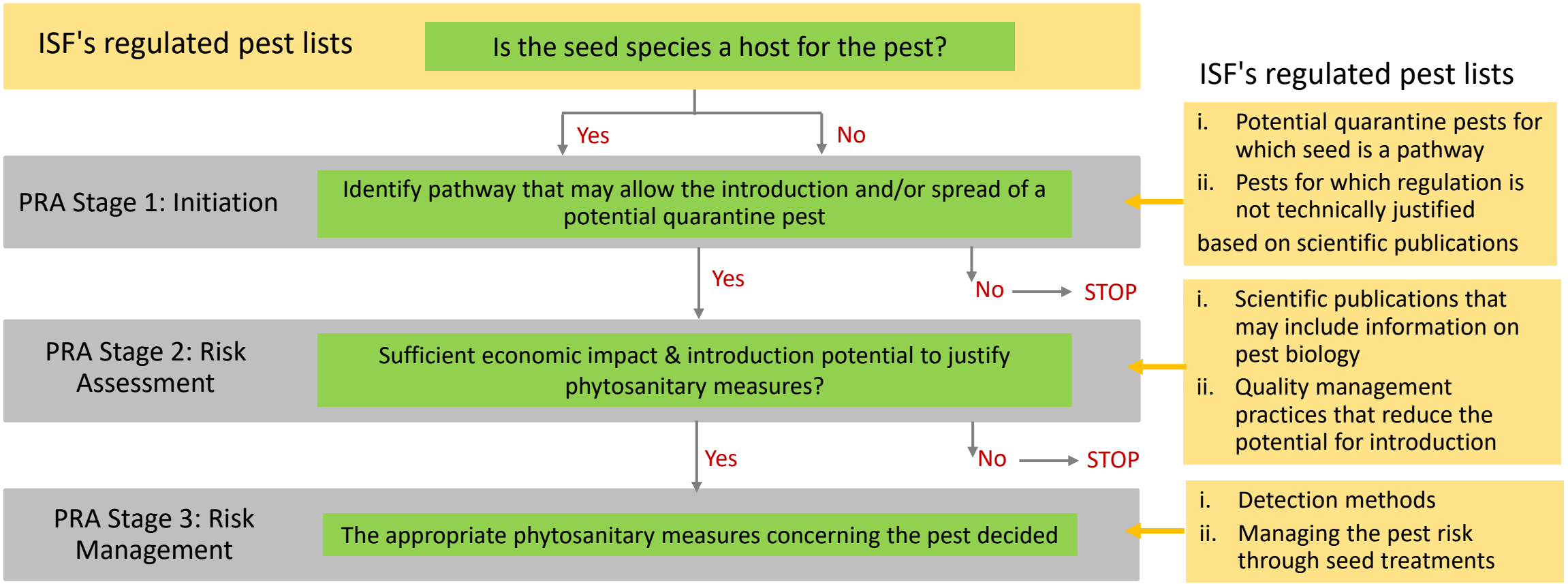
784 items in table, 107 items shown, 677 items filtered out.

		Pest				Pest classification			Detection				Risk mitigation			
Species	Crop	Scientific Name	Additional Info	Complementary Info	Type	Is seed a pathway in this crop?	References	Remarks	Is there a seed test?	If yes, type of test	References	Remarks	Can the pest be managed by seed treatment(s)?	If yes, what type(s)?	References	Remarks
Capsicum annuum	Pepper	Athelia rolfsii		Anamorph: Sclerotium rolfsii	Fungus	No	1-23, 1-40, 1-73	Pepper is a host, however, no references found indicating seed as a pathway for A. rolfsii in pepper. **Available information indicates there is no scientific basis for regulation of A. rolfsii on pepper seed.**								
Capsicum annuum	Pepper	Corcyra cephalonica			Insect	No	1-158, 1-159, 1-160	No references found indicating seed as a pathway for the rice meal moth on pepper. This insect is associated with rice, corn, soybean and other grains. Black pepper (Piper nigrum) extracts are sometimes used to control the insect. **Available information indicates there is no scientific basis for regulation of C. cephalonica on pepper seed.**								
Capsicum annuum	Pepper	Colletotrichum gloeosporioides					1-141, 1-142	ausal agents of anthracnose of mmonly seen in pepper seed fected, seed can be a pathway r. A quality systems approach crop inspections and careful selection of healthy fruit should reduce the chances of seed contamination. Commercial harvesting (avoiding infected fruit), cleaning and sanitization of pepper seed would reduce the potential for seed contamination.	Yes	Incubation	1-10, 1-20	Several methods are compared in reference 1-10.	Yes	Chemical (seed coating)		No references found, however, a seed treatment (such as Thiram slurry), used as a prophylactic measure, may be effective against the fungus.
								Seed is a known pathway for PMMV in pepper and the				An ISHI-Veg method is described. A sample of				There are a number of methods described for

[1-141] da Silva Franco, C.I.C., de Sant' Anna, J. R., Rosada, L.C.J., Kaneshima, E.N., Stangarlin, J.R., and de Castro-Prado, M.A.A. (2011). Vegetative compatibility groups and parasexual segregation in Colletotrichum acutatum isolates infecting different hosts. Phytopathology, 101, 923-928.

https://pestlist.worldseed.org/public/pestlist.jsp

ISF's regulated pest lists and PRAs



Is seed a pathway?

Seed Species	Regulated pests (no.)	References cited (no.)	Is seed a pathway? (no.)			
			Yes	Pathway not proven	No	Not a host
Bean	97	413	23	14	41	19
Brassica	118	380	11	12	52	43
Carrot	92	259	4	7	43	38
Cucumber	90	205	4	8	50	28
Lettuce	64	156	3	10	36	15
Melon	69	178	6	14	33	16
Onion	94	183	7	12	43	32
Pepper	107	256	9	19	45	34
Spinach	38	105	8	3	13	13
Squash & pumpkin	54	208	5	8	29	12
Tomato	178	579	14	35	89	40
Watermelon	58	212	4	7	31	16
		Average (%)	9	14	48	29

ISF's Regulated Pest List Database
Its potential benefits

- Quick reference for companies to see what is available in terms of risk mitigation (seed tests and seed treatments)
- Cost savings directly to companies with fewer seed tests for Phyto ADs
- A tool that allows the industry to respond to new reports regarding seed as a pathway
- Establish the credibility of the seed industry as a stakeholder
- Eliminate irrelevant Phyto ADs
- Promote science based national regulations
- Work together with NPPOs in mutual trust and confidence to manage phytosanitary risks better

Seed health testing: some challenges

- The regulatory environment
  - The requirement to test for pests for which seed is not a pathway or the crop is not a host
  - Use of protocols suitable to test seed
  - Reliability of tests
  - Harmonisation of tests
- Technological Innovations
  - Rapid developments in techniques
    - Sensitivity of tools
    - Adaptation and validation to ensure sound and reliable results that have biological “relevance”
  - Adaptation of tests for treated seed
    - Sanitation products and processes

International Seed Health Initiative (ISHI)

- Validated seed health testing methods
  - Methods publicly available via ISF website
  - Methods also approved by external bodies such as International Seed Testing Association (ISTA) and National Seed Health System (US)
  - Monitor method performance after being in use for some years, method improvement if found insufficient
- Best practices for the use of different assays used in seed health testing
  - The type and number of controls used in routine seed health testing to ensure accurate and reliable results
- Technical papers related to seed health testing

https://www.worldseed.org/our-work/phytosanitary-matters/seed-health/

ISF's position on direct and indirect tests

A seed health test to detect the presence of a pathogen known to be seed-transmitted generally consists of 3 primary steps:

1. isolating/extracting the disease-causing pathogen from seeds
2. detecting and identifying it, and lastly
3. confirming its viability and pathogenicity

→ With such a **direct test**, the living presence of a pathogen on or in the seed is demonstrated and its pathogenicity confirmed

Faster, simpler and relatively inexpensive indirect tests, such as PCR and ELISA, detect the presence of proteins or nucleic acids specific to the pathogen in seed, without demonstrating pathogen viability and pathogenicity

→ With such an **indirect test**, a positive result shows only an association of the suspect pathogen with the host tissue. Association is not necessarily causality!

ISF's position on direct and indirect tests

1. If an **ELISA or PCR** test yields a **negative result**
   - then no confirmatory test is necessary and the seed lot being tested is considered healthy

2. If an **ELISA or PCR** test yields a **positive result**
   - the seed lot is suspected of being infected with the target pathogen, and a confirmatory test must be conducted to demonstrate that the target pathogen is viable and pathogenic

GUIDANCE

Use **indirect tests** as a **pre-screen**; if the test result is negative, the seed lot is healthy. A positive test result is a presumptive positive and requires additional testing to complete the diagnostic determination of the seed lot.

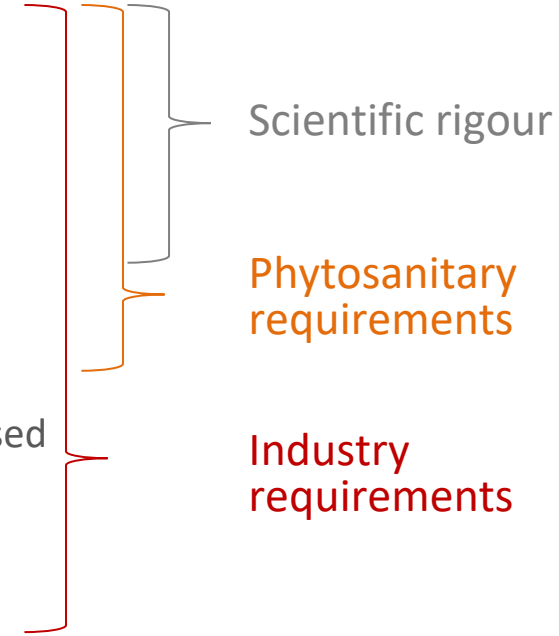
The ideal seed health test

... prevents

- infected seed lots from being shipped and sold as a consequence of a false negative test result
- seed lots from being destroyed as a consequence of a false positive test result

... is meaningful only if it is a reliable reflection of the risk that is present when the seed lot is brought into the market

- Specific to the relevant pathogen
- Matrix (for seed, leaves, treated seed)
- Sufficiently sensitive
- Validation of the test (supporting data)
- Determine viability of the pathogen (dead or alive)
- Harmonised (to minimize differences in methods used by seed companies)
- Robust (usable by all labs)
- Quick to use (facilitates routine testing)



How the industry functions ....at a glance

Seed industry goal: generate and deliver a product that meets customer needs

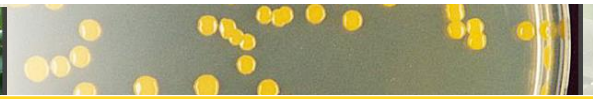
- At the *RIGHT Time*
- At the *RIGHT Cost*
- At the *RIGHT Quality*: germination, vigor, hybridity, healthy seed

Failure to do so may result in a loss of sales or customer…

Great efforts made by many companies to safeguard seed supply and to meet customer needs

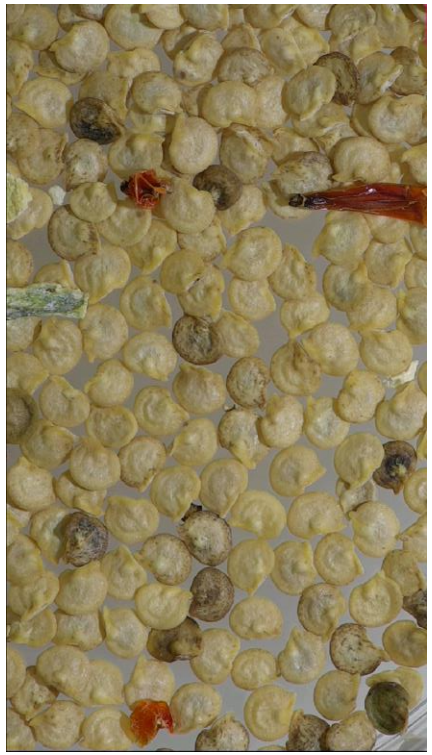
- Establish reliable production locations
- Apply field management practices
- Apply standard operational practices (sorting, sanitation, treating, etc.)
- Apply standard quality tests
- Use accreditations to leverage quality testing for seed movement and import
- Continuously improve through risk assessment and mitigation, root cause for improvements

Quality Management System


Standard quality management practices

Scientific assessment overlaid with hands-on experience gained during seed production and from applying quality management systems



Seed on arrival following basic cleaning off-shore

Shriveled and small seed removed

Doubles, discoloured & inert material cleaned

Seed checked again for light seed & inert material

Seed uniform in shape and size; with a developed embryo, good seed coat

How ISF supports phytosanitary/regulatory policy and facilitates safe global seed movement

Recognising the sovereign right of countries to utilise phytosanitary regulations on the international movement of seed

- actively finding mechanisms that ensure the safe movement of seeds in international trade in order to protect agriculture, human health and the environment
- promoting science-based national regulations
- working with other stakeholders (academic community, NPPOs) in mutual trust and confidence to manage phytosanitary risks better
- establishing the credibility of the seed industry as a key stakeholder

Seed is Life